

## Instituto Geográfico Nacional of Spain

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### Abstract

This report updates the description of the Yebes Observatory facilities as an IVS Network Station. The Yebes 40-m radio telescope has performed geodetic VLBI observations regularly since September 2008. In addition to this, the project to establish an Atlantic Network of Geodynamical and Space Stations (RAEGE) is progressing well, and the construction of the first three antennas of VLBI2010 specifications has been contracted.

### 1. General Information: the IGN Facilities at Yebes

The radio telescopes (the new 40-m and the old 14-m which was an IVS Network Station since 2003) are located at the Observatory of Yebes, a department of the Instituto Geográfico Nacional (IGN, Ministerio de Fomento).

Yebes Observatory is also the reference station for the Spanish GNSS network and holds permanent facilities for gravimetry. The RAEGE project will provide a new VLBI2010-type antenna in Yebes in 2012. An SLR system in a new control building will also be built in the near future.

### 2. IGN Staff Working on VLBI Projects

Table 1 lists the IGN staff who are involved in geodetic VLBI studies and operations. The VLBI activities are also supported by other staff such as receiver engineers, computer managers, secretaries, and students. The process of hiring dedicated telescope operators has suffered delays, not being yet available; this limits the amount of observing time that Yebes can offer to the IVS.

Table 1. Staff in the IGN VLBI group (Email: [vlbitech@oan.es](mailto:vlbitech@oan.es)).

Name	Background	Role	Address*
Francisco Colomer	Astronomer	VLBI Project coordinator	ROM, IGN
Pablo de Vicente	Astronomer	VLBI Technical coordinator	CAY
Susana García–Espada	Engineer	geoVLBI expert	CAY
Jesús Gómez–González	Astronomer	Deputy Director for Astronomy, Geodesy and Geophysics	IGN
José Antonio López–Fdez	Engineer	Yebes site manager	CAY
Javier López–Ramasco	Geodesist	Geodesist	CAY
Alvaro Santamaría	Geodesist	Geodesist	CAY

#### Addresses:

**ROM:** Real Observatorio de Madrid. Calle Alfonso XII, 3. E–28014 Madrid, Spain.

**CAY:** Centro Astronómico de Yebes. Apartado 148, E–19080 Guadalajara, Spain.

**IGN:** Instituto Geográfico Nacional. Calle General Ibañez de Ibero 3, E–28003 Madrid, Spain.

Table 2. Characteristics of the Yebes 40-m geodetic VLBI station.

Parameter	Value	DAR	VLBA5 (14) + VSI-C
Diameter	40 meter	Recorder	Mark 5B
Receivers	2 - 115 GHz	H-maser	T4-Science iMaser 3000
S/X $T_{\text{sys}}$	190/50 K	GPS	TrueTime XL-DC
S/X SEFD	1400/210 Jy	Weather station	SEAC-EMC

### 3. Status of Geodetic VLBI Activities at IGN

The 40-m radio telescope has participated in 18 sessions, of the EURO, R4, and T2 types. One was lost (R4425, bad disk reported).

Yebes has been connected to GÉANT at 1 Gbps since April 2009. Ways to increase the capacity are under consideration.

A new Hydrogen maser has been purchased, to replace the Russian KVART-73 maser which failed in 2009 after 13 years of successful operation.

An absolute gravimeter is now permanently placed at the new building in Yebes. A GWR superconducting gravimeter was installed in May 2010 (see Fig. 1).



Figure 1. GWR superconducting gravimeter installed in a dedicated building in Yebes.

Cooperation with the geodesy group at Onsala Space Observatory in Sweden continued by modeling the tropospheric effect caused by neutral atmosphere using the HIRLAM 3D-VAR numerical weather prediction model, where a direct improved mapping function is calculated using raytracing. First results were presented at the IVS 2010 General Meeting in Hobart (Australia).

## 4. Project RAEGE

IGN has started the construction in Spain and Portugal of a network of four new Fundamental Geodynamical and Space Stations. The project, named *RAEGE* (after “**R**ed **A**tlántica de **E**staciones **G**eodinámicas y **E**spaciales”), consists of the erection in Yebes (1), Canary Islands (1), and Azores Islands (2), of one radio telescope of VLBI2010 class (i.e. of 13.2-m diameter, high slew rate, capable of operating in the 2-14 GHz bands but also up to 90 GHz), a permanent GNSS receiver, a gravimeter, and (at least in Yebes) an SLR station.

Radio frequency interference (RFI) has been monitored at the Yebes station and the chosen sites at the Santa María (see Fig. 2) and Flores Island of the Azores, demonstrating that in the latter cases the spectrum in the band of interest is very clean.

The construction of three antennas, to be installed in Yebes, Azores (Santa María), and Canary Islands, has been contracted to MT Mechatronics (Germany). The first antenna (see Fig. 3) will be erected in Yebes in 2012, shortly followed by the antenna in Santa María.

A cooperation with the Institute of Seismology (IoS) of the Chinese Academy of Sciences will allow the loan of a mobile SLR system to Yebes in 2011. This system will operate until the fixed SLR station is built.

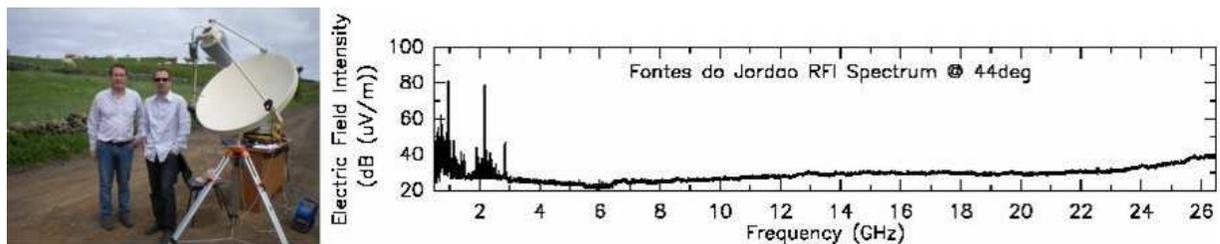


Figure 2. RFI measurement at the RAEGE station in Santa María, Azores Islands.

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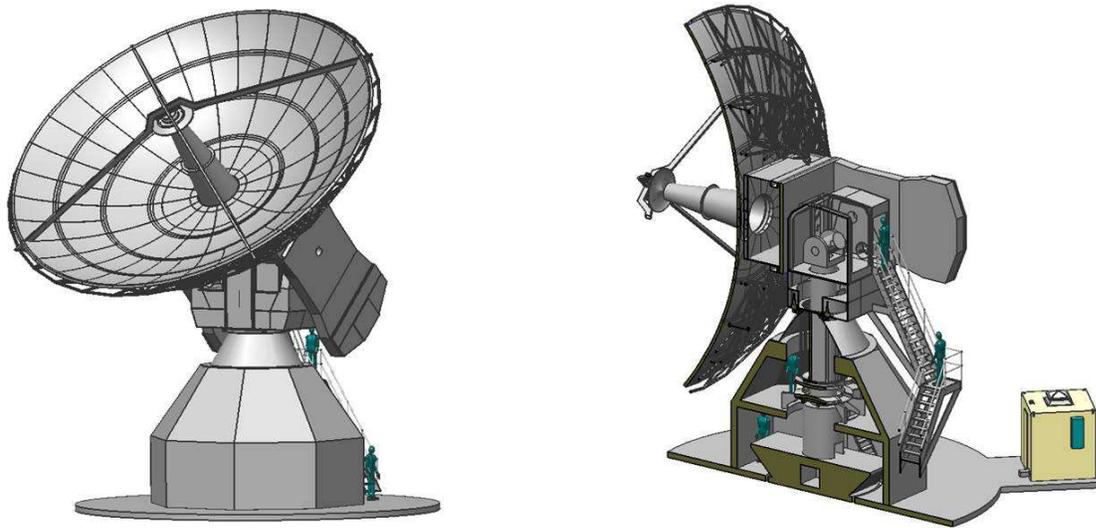


Figure 3. Design of the VLBI2010 antennas for RAEGE.

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